



RAID

Real-time Adversarial Intelligence & Decision-making

**Briefing to Industry
BAA 04-16**

*17 March 2004
Arlington VA*

Sponsored by DARPA/IXO

Unsolved Service Requirements

◆ Army – Predictive Analysis

- ... used in the US Army community to denote a process and tools for predicting future enemy actions.
- When the operation is executed, the commander and staff make the necessary changes ... while continually visualizing the possible future actions and reactions of the enemy.

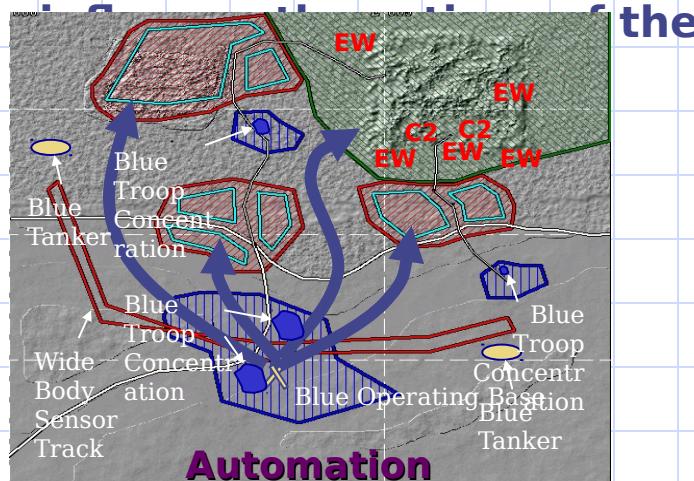
◆ Air Force – Predictive Battlespace Awareness

- ... refers to future techniques and technologies that would help the commander and staff to characterize and predict likely enemy courses of action, to relate the history of the enemy's performance to its current and future actions, and to associate these predictions with opportunities for friendly actions and effects.

Today's Technologies Fail to Address the Problem

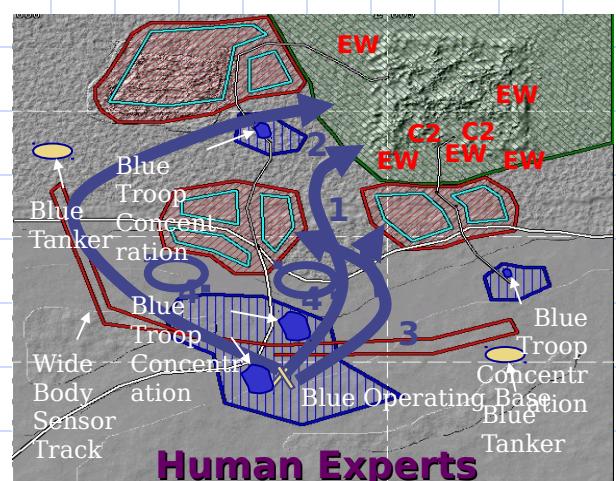
Today's Automation:

- Detailed optimization of resource allocation, times, & routes
- No attempt to infer or to impact the actions of the



Humans:

- Focused on impacting actions of the Red, by deception and exploiting Red errors



Recent experimentation compared the task planning and resource allocations produced by advanced automation to those produced by humans. Lack of consideration for the adversary's moves and countermoves was identified as a key functional shortfall in the automation.

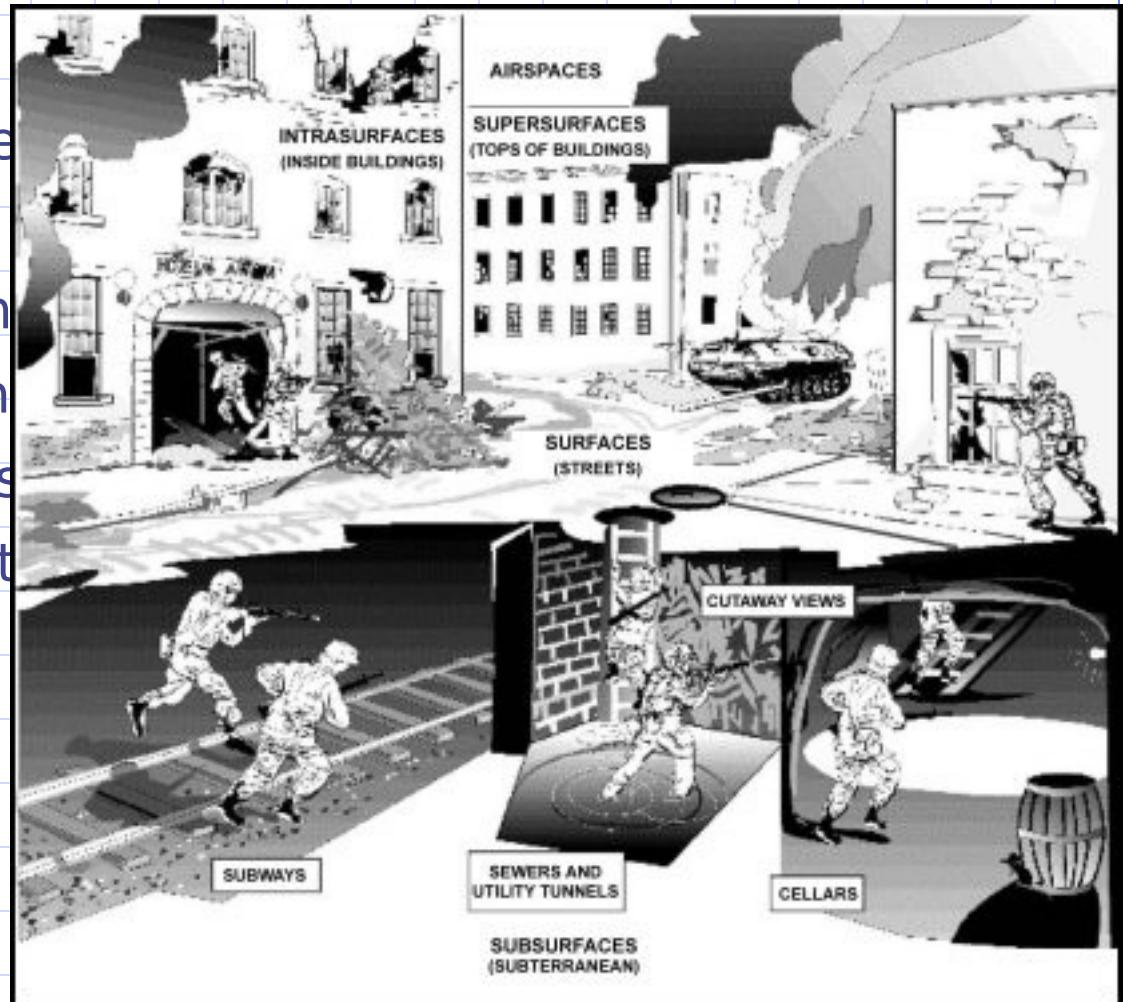
RAID Objective

A tool for:

- ◆ **real-time anticipation of enemy actions**
- ◆ **in tactical ground operations**

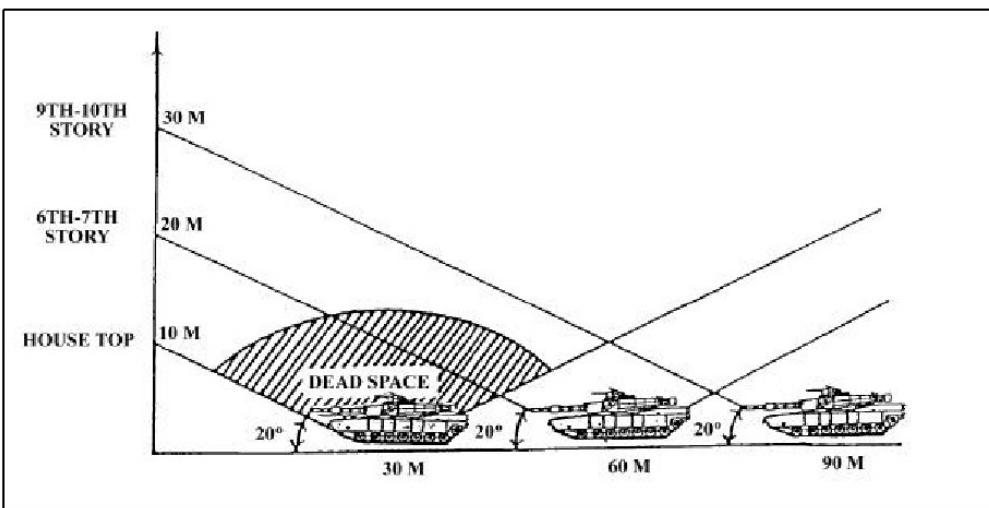
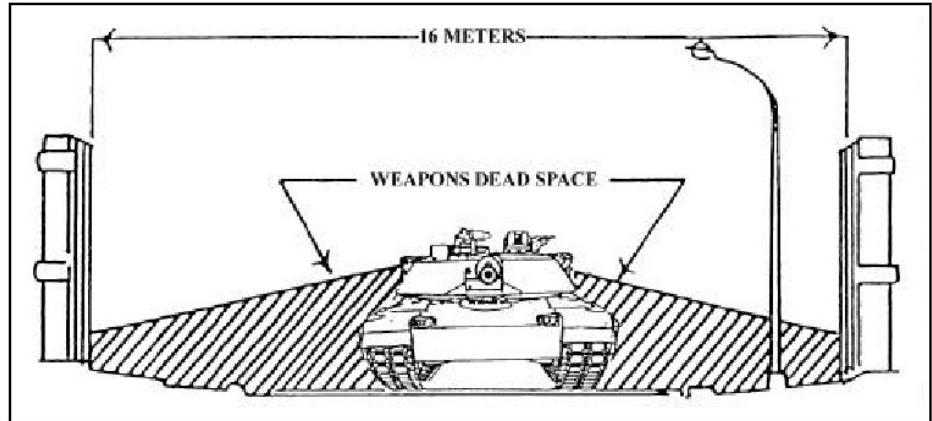
The Problem Domain Urban Operations

- ◆ Full 3-D
- ◆ Dynamic Environment
- ◆ Lines Open/Close
- ◆ Barriers Close/Open
- ◆ Limited Line-of-Sight
- ◆ Unlimited Hide Sites
- ◆ Weapons Constraints
- ◆ Combat ID
- ◆ Non-combatants
- ◆ Protected Sites



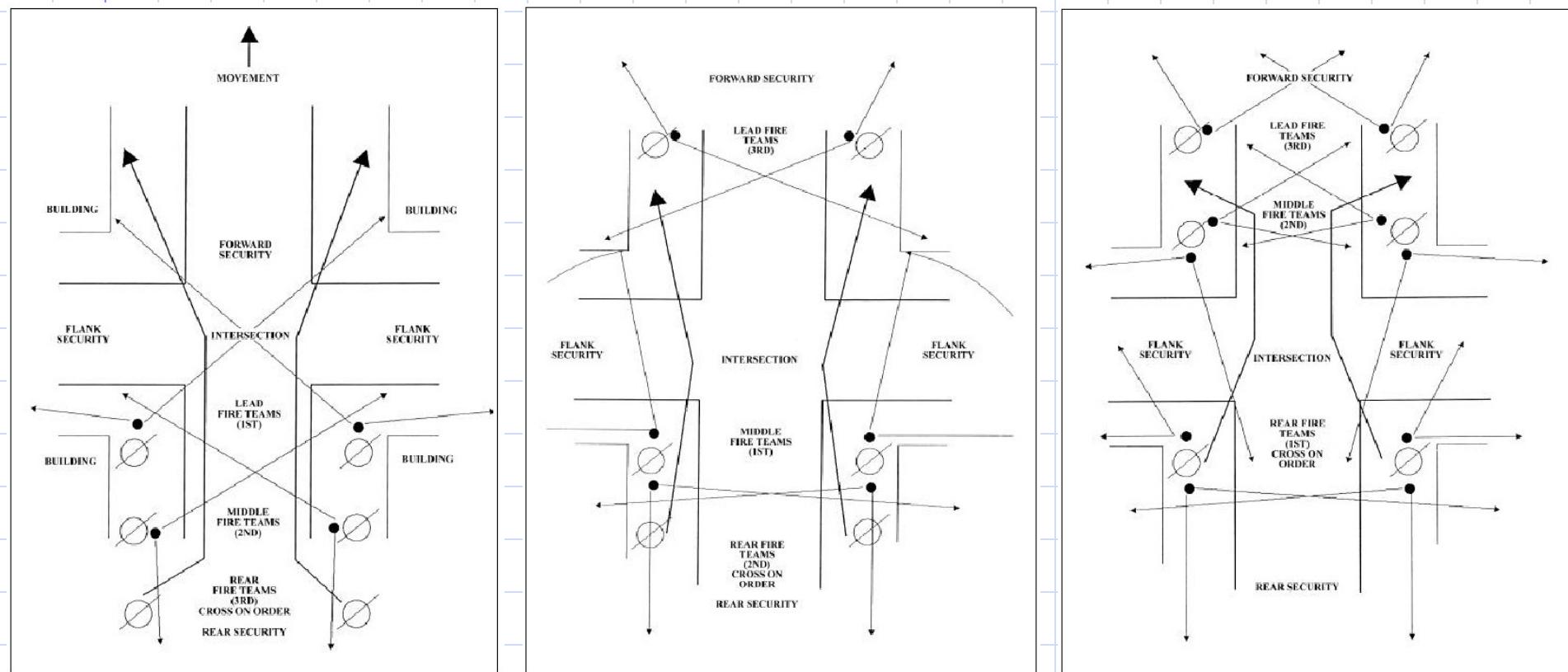
The Problem Domain Urban Operations

Consideration of weapon capabilities and limitations. For example, tanks have multiple dead zones and trajectory limits, which can make them vulnerable in an urban environment.



The Problem Domain Urban Operations

Consideration of urban tactics. For example, crossing an intersection requires multiple, coordinated moves.



Step 1 - Isolate and Suppress

Step 2 - Cross Over

Step 3 - Cover and Proceed

Vision of the RAID Program

Develop a near real-time adversarial predictive analysis tool that operates as an automated Red predictor providing a continuously updated picture of probable Red actions in tactical ground

open

per Dismo

Next Generation FBCB2



Decisions

Mounted

Blue / Red
picture plus
Blue plan /
FRAGO overlay



Battlespace

DCGS-A

RAID

RAID Program (BAA 04-16)

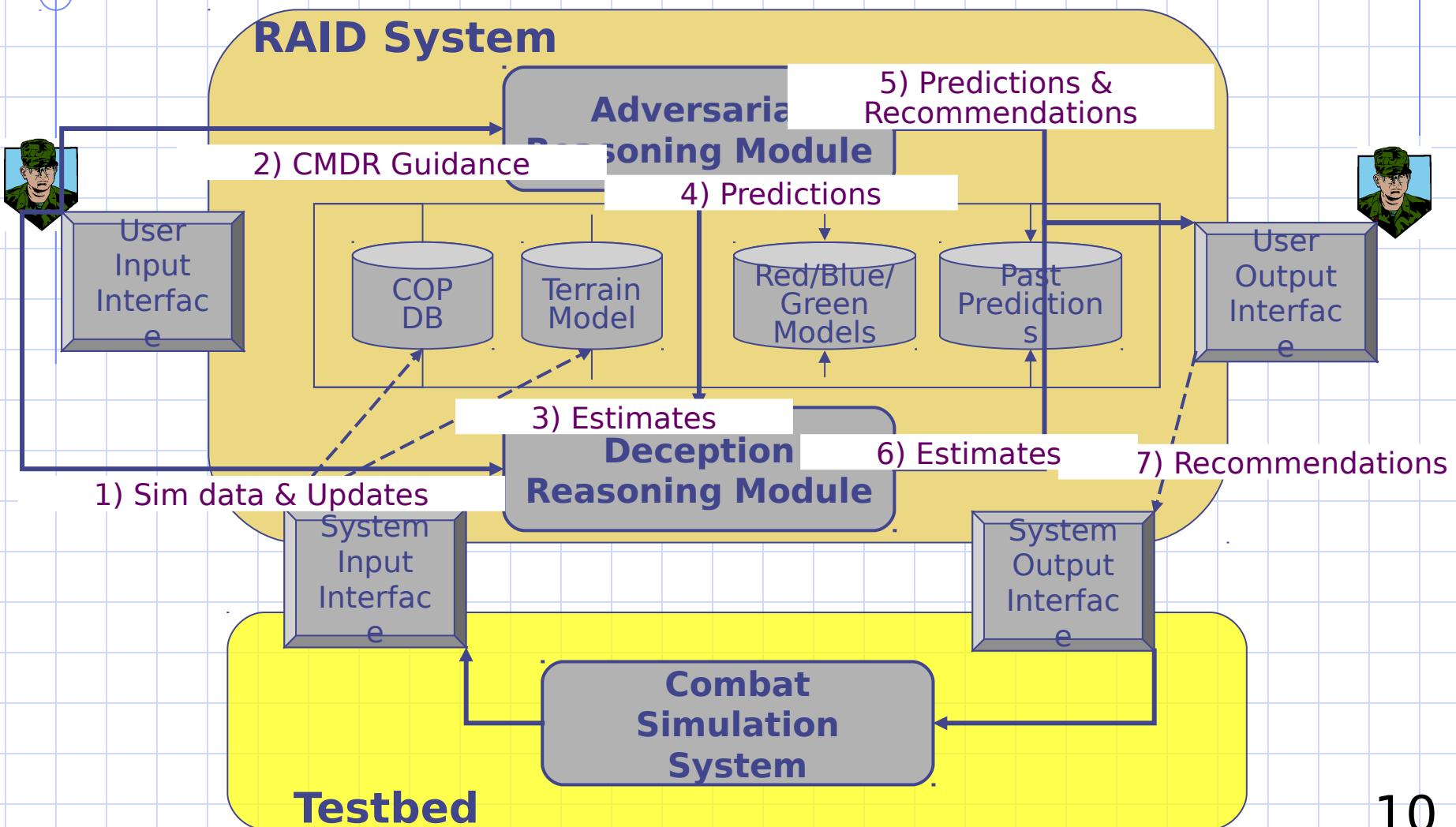
Real-time prediction of
enemy actions/
reactions/counteractions
for tactically meaningful
time horizon

Blue and Red entities
locations and limited
status / posture / action
info

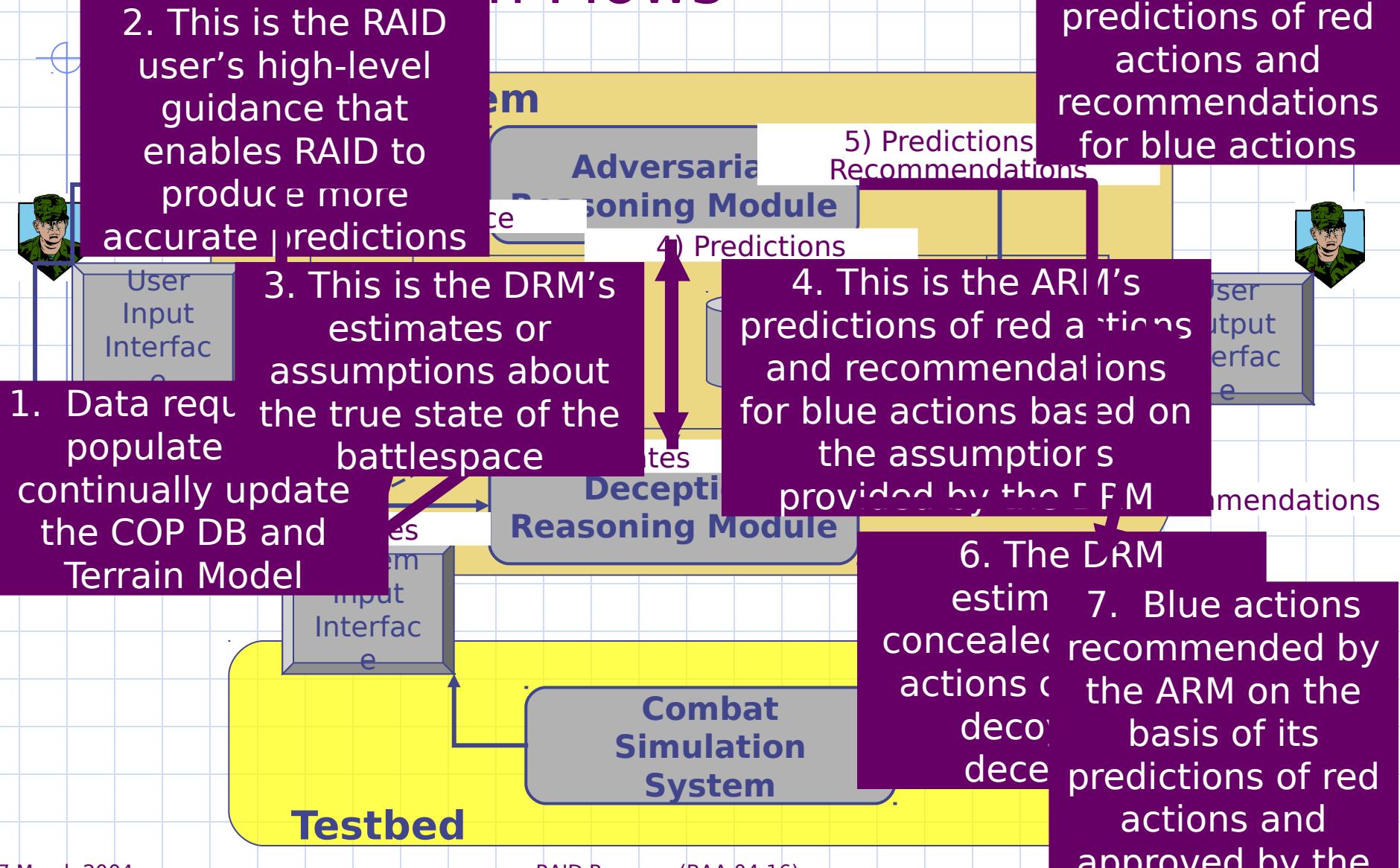


Program Structure

RAID System Concept



RAID System Concept Information Flows



Program Schedule

FY04				FY05				FY06				FY07				
Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	
Theme of the Phase		Phase I				Phase II				Phase III						
Core Technologies		Adversarial anticipation and counteraction				Adversarial reasoning about concealment and deception				Integration and Transition						
Adversarial Reasoning, Deception Reasoning		Combatant models				Partial information				Breadth and Robustness						
Adversarial Reasoning, Deception Reasoning		Anticipate and counteract				Concealment and Deception				Transition-driven extensions						
Integration		Feints and attacks				Human preferences										
Integration		w/ sim system				w/ sim system				w/ DCGS-A system						
Experimentation and Evaluation		 Virtual				RAID performs action-reaction-counteraction predictive analysis				RAID detects/anticipates adversary's concealment and deception				RAID is used with operational C2 and ISR systems		

Security

- ◆ The RAID Program will be **CLASSIFIED** in accordance with the DD Form 254 associated with the PIP.
- ◆ The prime contractor in each of the four task areas must comply with US National Security Requirements and Export Control Laws.
- ◆ However, the basic research in the two technology areas (Adversarial Reasoning and Deception Reasoning) can be performed by an **UNCLASSIFIED** subcontractor, such as a university.
- ◆ Proposals submitted in response to this BAA shall be **UNCLASSIFIED**.



Technical Objectives and Experimental Approach

Overarching Technical Challenges

- ◆ Tight interdependence, coupling of blue and red actions.
- ◆ Blue knowledge of red assets and actions is inevitably limited. Observations as well as interpretations of the observations are subject to a significant degree of errors and latency.
- ◆ In addition to partial, delayed and often erroneous observations, the battlefield knowledge is limited by a purposeful, continuous, aggressive, intelligent concealment and deception.
- ◆ Cultural, doctrinal, psychological effects. It is not enough to consider the most dangerous course of action. The most likely course of action can be significantly different from the theoretically most advantageous one.
- ◆ Complex urban terrain offers a high density of threats and opportunities for forces. Further, the terrain itself is dynamic because it is modified by human actions.
- ◆ The presence of non-combatants on the battlefield must be explicitly considered.
- ◆ Fire and maneuver of forces are not the only actions that must be carefully considered. Intelligence gathering, communications, and logistics (including casualty evacuation) are tightly coupled with fire and maneuver.
- ◆ The scale of the computational problem is immense and yet solutions must be generated in near real-time.
- ◆ To be of practical value, a successful technical approach must allow for easy modification and extension of the coverage.

Candidate Technical Approaches

- ◆ Any technology or a combination of technologies that addresses the problem and the challenges discussed in relation to the Adversarial Reasoning and Deception Reasoning, and which can be developed in a manner consistent with the RAID program concept, would be of interest to this BAA. Potential candidate groups of technologies include but are not limited to:
 - Game-theoretic and game-playing approaches: Devising sequences of actions for both red and blue forces in a manner that assumes both sides strive to maximize the achievement of their respective objectives.
 - Adversarial planning: Forming plans for both red and blue actions that lead to the achievement of the respective desired goals while preventing the attainment of the goals of the other side.
 - Deception discovery: Analyzing the information state from risk-sensitive perspective to determine which of alternative hypotheses would benefit the enemy the most if accepted by the friendly forces.
 - Pattern recognition: Identifying patterns and anomalies in spatial and temporal locations, movements and other actions of the red force that could indicate concealment, deception and future intended course of action.

Challenge Problem and Scenarios

Developed by Thomas Garrett,
MG USA (Ret).

Three (3) Scenarios

- Seize and control several key intersections in a city.
- Search, clear and secure built-up area near an airfield.
- Arrest urban guerilla leaders; avoid collateral damage.

Blue Force – Company Sized Unit

- Several light armored vehicles, helicopters or fixed wing CAS
- Supported by joint, close supporting fires, including Netfires

Red Force – experienced and motivated urban fighters

- Up to 200 fighters in teams of 3-7 personnel
- Small arms, RPGs, mortars, heavy machine guns, MANPADS,
- Strong knowledge of terrain
- Blends with and assisted by civilians

Urban or built-up terrain; space ~ 5x5 km; time ~ 8 hrs

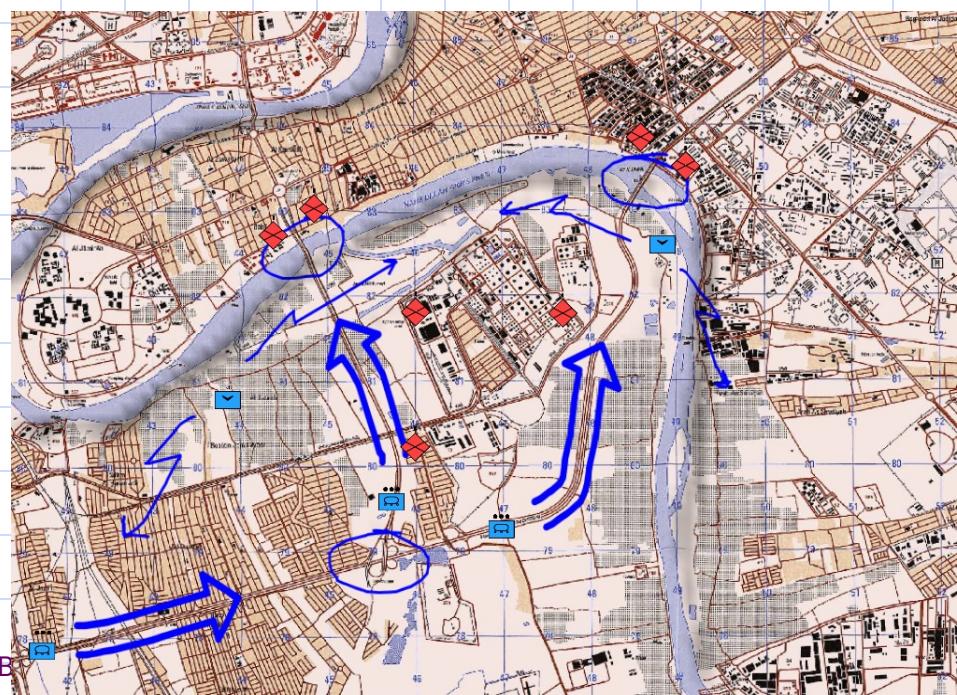
Role of RAID (e.g., application within future DCGS-A):

- Watch the rapidly evolving COP;
- Deliver to the Company Commander (via FBCB2 or handheld CDA) real-time predictions on upcoming RED actions (movements, ambushes, etc.) and suggested BLUE counteractions.
- Perform the analysis unobtrusively, on demand, in less than 30 seconds and look forward 15-300 minutes as requested.

Challenge Problem

Scenario 1 – Control the Bridges

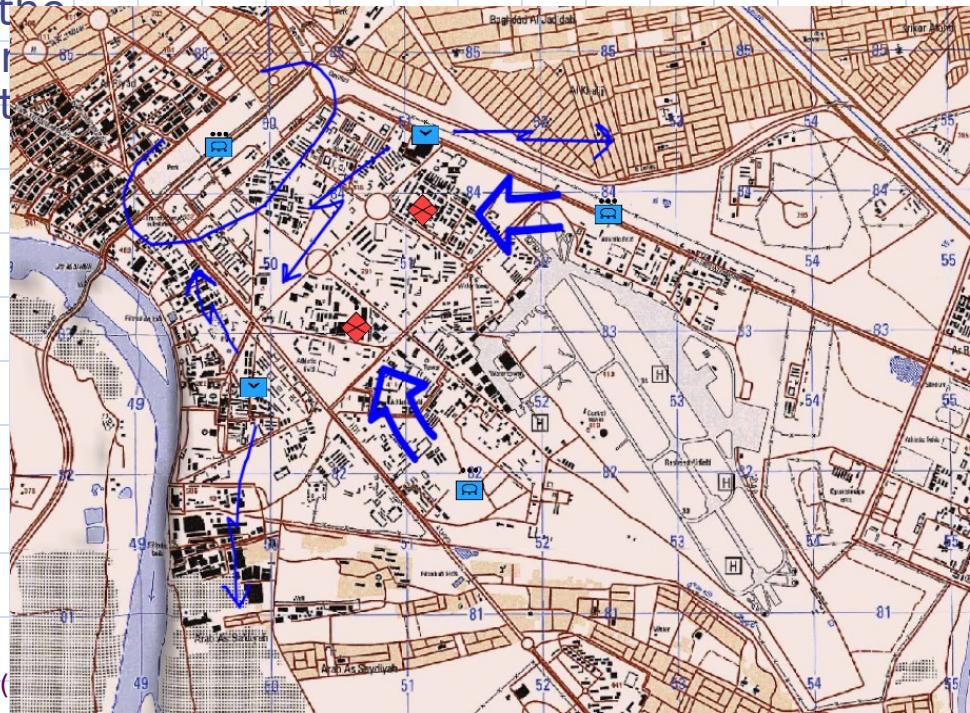
- ◆ **Mission:** Attack to seize key intersections controlling approaches to key bridges that lead to the heart of the city. Continue the attack to seize and secure 2 key bridges.
- ◆ **Situation:** BLUFOR is attacking into the heart of large urban capital city. A RAID supported company is operating as an advanced element. The weather is clear.
- ◆ **Red Force:** Remnants of regular forces, irregular forces, and small extremist elements from outside the country defend the bridges with anti-tank weapons, heavy machine guns, mortars, rockets, and MANPADS. The approaches are mined, and the mines are covered by ambushing fire.
- ◆ **Time:** This is a night approach. The broader attack to this point has been extremely fast paced and relentless. The concept is to keep the momentum of the assault going. A follow-on force will cross the bridges, pass through our company, and enter the heart of the city.



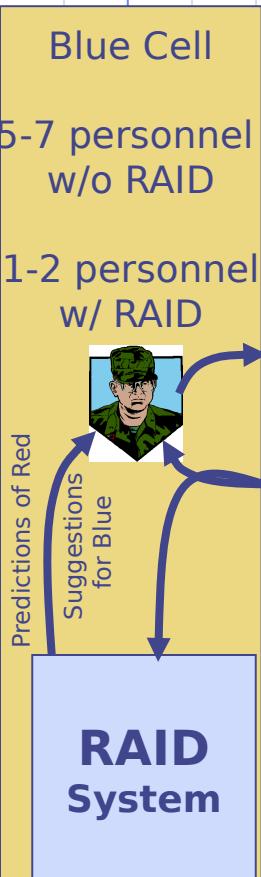
Challenge Problem

Scenario 2 - Secure Area West Of Airfield

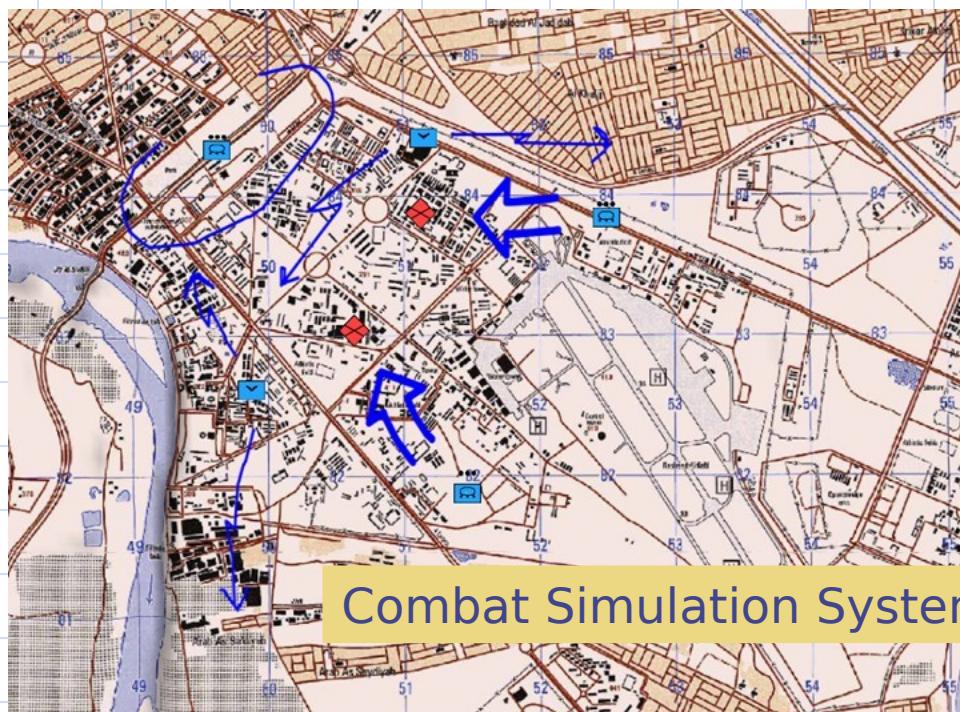
- ◆ **Mission:** Search, clear and secure area west of airfield.
- ◆ **Situation:** Aircraft using the airfield have been fired upon from the surrounding neighborhood. Weather is day and there is a dust storm.
- ◆ **Red Force:** Small insurgent teams armed with SA-7, SA-18, and RPGs, as well as small arms are believed to be moving into and out of the area under the cover of darkness and adverse weather, and engaging approaching and departing aircraft.
- ◆ **Time:** Need to swiftly cordon off the area, then systematically search and clear. Establish a sustained security of the area to prevent it's use by insurgents.



Overview of Experimental Approach



Control Cell (2-3 personnel)
enforces realism and integrity of the wargame

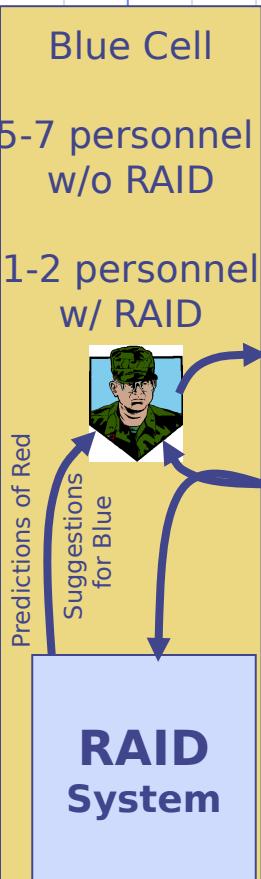


Red Cell
5-7 personnel

Commands
agile and
aggressive
Red Force

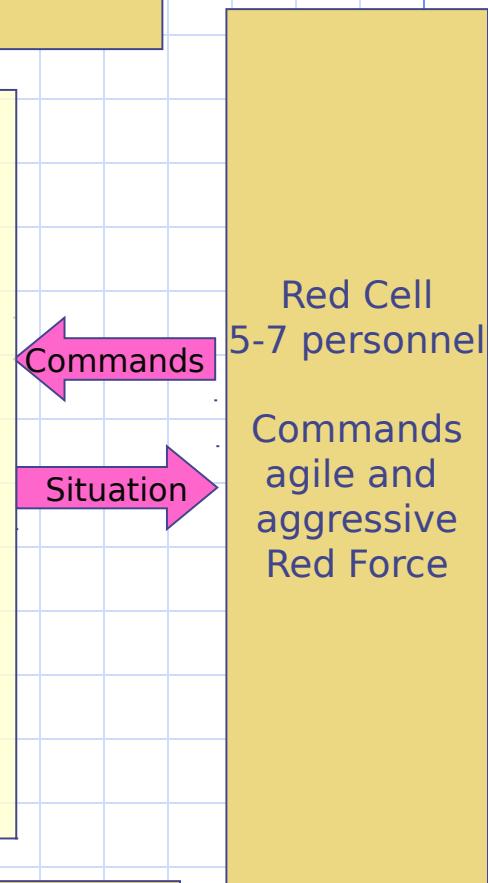
Data collection and analysis cell (1-2 personnel)
computes scores and predictive accuracy w/ and w/o RAID

Overview of Experimental Approach (cont.)



Control Cell (2-3 personnel) enforces realism and integrity of the wargame

- Each series is 5-10 benchmark games (without RAID) and 5-10 test games (with RAID), duration 2-6 hours
- Simulation software
- Hardware: up to 20 PCs
- Interfaces: Phase 1,2 – RAID/Simulation; Phase 3 – RAID/DCGS-A/ASAS-L/FBCB2/CDA
- Game scoring scheme: points for mission completion within time allotted; enemy captured and killed; penalties for friendly losses and collateral casualties.
- Complexity of the problem varies by number and granularity of red/blue units; allowed set of actions; weapons



Data collection and analysis cell (1-2 personnel) computes scores and predictive accuracy w/ and w/o RAID



Experimental Plan

	Phase 1	Phase 2	Phase 3
Thrust	Action-reaction-counteraction	Concealment and deception	Breadth, robustness, transition
Experiment Design	10 benchmark, 10 test games, compare scores	Add: compare accuracy of predictive estimates	In CPX-like setup, integrated with FCBC2, CDA, ASAS-L, DCGS-A
OPFOR	Up to 20 teams of 3 fighters each w/ small arms, RPGs	Up to 30 teams of 3-7. Add sniper rifles, MGs, MANPADS	200 fighters, dynamically formed teams. Add mortars, rockets
BLUFOR	Company-sized force w/ several armored vehicles	Add air support (helicopters)	Add CAS, joint close support fires, air mobility
Terrain Representation	Buildings and floors, aggregated interiors	Add breached openings in bldgs; basements, internal passages	Add underground corridors of mobility, overpass, fences, walls, urban clutter
Intel Capabilities	Full state known to both sides	Observations by troops	Add UGS and UAV sensors
Organization	Flat organization of fixed small teams with single command node	Company w/ three fixed platoons	Dynamic reorganization and reattachment
Communications	Implicit idealized instant broadcast	Comms and info processing delays	Differentiated nets with realistic delays and sporadic loss
Casualty Mgmt	Implicit immediate evacuation	Treatment, delayed evacuation	Add explicit medevac actions
Logistics	Implicit continuous resupply	Run out of ammo, delays in resupply	Explicit resupply actions
Civilians	Random presence and reactions	Civilians help red resupply, intel	Blue actions to manage civilians
Concealment,	Feint movements and	Concealment, stealthy	Decoys, civilians as



Proposal Management



Significant BAA Events and Deadlines

DATE	EVENT	URL
1 March 2004	FedBizOpps Announcement and Proposer Information Package published	http://www.darpa.mil/ixo/solicitations/raid/index.htm -
17 March 2004	DARPA Briefing to Industry on proposal process and BAA technical topics	https://www.tfims.darpa.mil/bti/
14 April 2004	Proposal registrations due at DARPA	http://www.tfims.darpa.mil/baa
21 April 2004	Proposals due at DARPA	http://www.tfims.darpa.mil/baa
1500 Hours		
21 May 2004	Selections expected to be announced	
Aug 2004	Kick-Off meeting	



Evaluation: Criteria for Awards

- ◆ Technical Depth and Feasibility
- ◆ Consistency with RAID Program Concepts
- ◆ Cost Realism and Value of Proposed Work to the Government
- ◆ Personnel and Corporate Capabilities and Experience



Electronic Correspondence

- ◆ Solicitation info at:
<http://www.darpa.mil/ixo/solicitations/raid/index.htm>
- ◆ Send Questions to: baa04-16@darpa.mil
- ◆ View FAQs at: <http://www.darpa.mil/ixo/solicitations/raid/index.htm>
- ◆ Electronic Submissions at: <http://www.tfims.darpa.mil/baa>
- ◆ T-FIMS Reporting is Mandatory
 - Monthly financial reports
 - Quarterly technical reports
 - Annual summary
 - Details at: http://www.tfims.darpa.mil/T-fims_req.doc/



DARPA Contracting Management Office (CMO)

BAA PROCESS

- ELEMENTS OF THE BAA
 - Synopsis in FEDBIZOPPS/FEDGRANTS
 - Proposer Information Pamphlet (PIP)
 - DD Form 254 (if applicable)
- TIME PERIOD(S)
 - BAA is open for 1 yr after date of publication
 - Proposal registrations due 14 Apr 04 (BAA tool)
 - Initial round of proposals due than 21 Apr 04
 - Proposals received after initial cut-off date will be evaluated/selected based on availability of subsequent program funding, if available.

BAA PROCESS

- **ELIGIBILITY**
 - All interested/qualified sources
 - Foreign participants/resources may participate (Security Regulations, Export Laws, as applicable)
- **PROPOSAL PREPARATION/SUBMISSION**
 - Instructions are detailed in the PIP
 - All questions to BAA04-16@darpa.mil
 - FAQ available on RAID website
 - All award/funding instruments (grant, cooperative agreement, technology investment agreement, contract, 845 prototype) are available as options but are subject to negotiation if proposal is selected

BAA PROCESS

- PROPOSAL PREPARATION/SUBMISSION CONT'D
 - Assert rights to all technical data and computer software proposed to be generated, developed, and/or delivered during performance
 - Proposals are treated by DARPA as Competitive Information/Source Selection Sensitive
 - PROPOSALS MAY BE HANDLED, FOR ADMINISTRATIVE PURPOSES ONLY, BY SUPPORT CONTRACTOR PERSONNEL SUBJECT TO NDA

BAA PROCESS

- EVALUATION/AWARD
 - No common Statement of Work - Proposals evaluated on individual merit and relevance as it relates to the stated research goals/objectives rather than against each other
 - Award Criteria: Technical Depth and Feasibility, Consistency with RAID Program Concepts, Cost Realism, and Personnel/Corporate Capabilities/Experience.
 - Government reserves the right to select for award all, some, or none of the proposals received and to award without discussions.
 - Government anticipates multiple awards
 - Only a duly authorized Contracting Officer may obligate the Government

BAA PROCESS

- COMMUNICATIONS
 - Prior to Issuing BAA – No restrictions, however Gov't (PM) shall not dictate solutions or transfer technology
 - After Issuing the BAA – No restrictions, however Gov't (PM/PCO) shall not dictate solutions or transfer technology
 - After Receipt of Proposals – Government (PM/PCO) may communicate with offerors in order to understand the meaning of some aspect of the proposal that is not clear or to obtain confirmation or substantiation of a proposed approach, solution, or cost estimate